TITLE

KEYLESS TOOLING SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part application of and claims the benefit of U.S. patent application Serial No. 10/127,782 filed on April 22, 2002, hereby incorporated herein by reference which claims the benefit of U.S. provisional patent application Serial No. 60/286,625, filed April 20, 2001.

BACKGROUND OF THE INVENTION

1. Field of the Invention:

This invention relates generally to a mill for the production of continuous seam-welded tubes or pipes and, more particularly, to a changeover system for changing roll tooling quickly, efficiently, and safely.

2. Description of the Prior Art:

Many mill sections of the prior art utilize rolls journaled between front and rear mill stands wherein the rolls are keyed to the journaled spindles. Such arrangements function well insofar as the metal forming operation is concerned, but are time consuming during changeover of tooling when it is necessary to remove the keys to successfully release the rolls to their respective spindles.

Changeover systems are an important part of current "high tech" mill lines. Recent innovations in this area

for both small and large diameter mills are effective for changing roll tooling. Shaping stands for production of large or small structural products have received a significant recent engineering effort to make roll changing quicker and easier. Cassette-type shaping stand designs are provided to automatically changeover and set roll gap. These developments provide the mill operators the ability to reduce downtime for roll changeover from hours to minutes.

It has been found that in certain instances it is desirable to quickly changeover a set of forming rolls without the utilization of the cassette-type changeover system. Therefore, the requirement of quickly, efficiently, and safely removing one set of forming rolls and replacing the same with a new set becomes manifest.

An object of the present invention is to produce a tooling system to facilitate the desired tooling changeover.

Another object of the invention is to produce a tooling system wherein the forming rolls are secured to the respective supporting spindles by a tapered bushing.

Still another object of the invention is to produce a keyless tooling system for readily securing a forming roll to a supporting spindle.

Another object of the invention is to produce a keyless tooling system employing a tapered bushing for

securing a forming roll to an associated supporting spindle.

Another object of the invention is to produce a keyless tooling system employing an associated driving member for locking and unlocking a bushing for securing a forming roll to a supporting spindle.

A further object of the invention is to produce a keyless tooling system incorporating an expandable bushing for securing a forming roll to a supporting spindle.

SUMMARY OF THE INVENTION

The above objects and advantages of the invention may typically be achieved by a tube mill apparatus for the production of continuous seam-welded tubes comprising: a tapered spindle having a tapered outer surface journaled for rotation between front and rear stands of the tube mill; an expandable tapered bushing juxtaposed on the tapered outer surface of the spindle; forming roll having a hollow central bore carried by an outer surface of the bushing; first driver for moving the bushing in a first direction to cause expansion of the bushing between the tapered surface of the spindle and hollow central bore of the forming roll; and second driver for moving the bushing in a second direction to cause contraction of the bushing between the tapered surface of the spindle and hollow central bore of the forming roll.

BRIEF DESCRIPTION OF THE DRAWINGS

The above, as well as other objects and advantages of the invention, will become readily manifest to those skilled in the art from considering the following detailed description of an embodiment of the invention when considered in the light of the attached drawings, in which:

Fig. 1 is an elevational view partially in section of the front and rear stands of the forming section of a tube mill embodying the features of the present invention;

Fig. 2 is an enlarged fragmentary view of the upper forming roll assembly illustrated in Fig. 1 more clearly illustrating the mechanism for expanding and contracting the tapered bushing of Fig. 1;

Fig. 3 is an end view of the tapered bushing illustrated in Figs. 1 and 2;

Fig. 4 is a sectional view of the tapered bushing illustrated in Fig. 3 taken along line 4-4 thereof; and

Fig. 5 is an end view of the tapered bushing illustrated in Figs. 3 and 4 taken from the end opposite that illustrated in Fig. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The specification, claims, and drawings of copending U.S. patent application Serial No. 10/127,392 filed April 22, 2002 is incorporated herein by reference.

Referring to the drawings, there is illustrated the rear and front stands of the forming section of a tube mill for the continuous production of seam-welded tubing. More specifically, there is illustrated a keyless spindle arrangement for coupling the cooperating forming rolls to their respective supporting spindles.

Fig. 1, in particular, illustrates a forming stand assembly of a tube mill including a rear stand 10 and a front stand 12. A pair of cooperating forming rolls 14 and 14' are supported for rotation on an upper spindle 16, and a lower spindle 16', respectively. It will be noted that the spindles 16 and 16' are tapered.

The forming rolls 14 and 14' are provided with hollow interior bores adapted to receive the respective spindle 16 and 16'. In order to maintain snug positive engagement between the forming rolls 14 and 14' and the respective spindles 16 and 16', there are provided tapered bushings 18 and 18', respectively. The bushings 18 and 18' are typically identical with one another. Accordingly, only a single bushing element 18 is clearly illustrated in Figs. 3, 4, and 5.

Since the structure and the interrelationship between the forming rolls 14 and 14', the respective spindles 16 and 16', and the tapered bushings 18 and 18' are identical in respect of the upper and lower roll assemblies, only the upper assembly will be described in detail. The upper spindle 16 is adapted to extend between the rear stand 10 and the front stand 12. The

respective ends of the spindle 16 are suitably journaled in the rear stand 10 and the front stand 12. The intermediate portion of the spindle 16 is provided with a tapered surface 20. The tapered surface 20 is adapted to receive the tapered bushing 18 and the associated upper forming roll 14. It will be understood that the forming rolls 14 and 14', and the associated respective tapered bushings 18 and 18' are either placed onto or removed from the respective spindles 16 and 16' during changeover when the front stand 12 is moved away from the normal operating position as illustrated in Fig. 1.

The tapered bushing 18 is typically formed from a cylindrical member 22 of alloy spring steel. The internal surface 24 of the cylindrical member 22 is machined to form a tapered central bore. Finally, slots 26 are formed by a machining operation, such as, for example milling or sawing. The slots 26 are formed to extend generally parallel to one another in spaced relation. Alternate end portions of the slots 26 remain joined together by bridges 26' at one end and bridges 26" at the opposite end.

When the selected forming rolls 14 and 14' are positioned on the respective spindles 16 and 16' with the associated tapered bushings 18 and 18' in place, the front stand 12 is moved into operative position and the appropriate clamping nuts 28 and 30 are applied to the appropriate spindles 16 and 16'. As the clamping nuts 28 and 30 are tightened, associated sleeves 32 and 34 of

the journal assemblies are urged against the outer end of the respective tapered bushings 18 and 18'. As clearly illustrated in Fig. 2, as the clamping nut 28 is tightened, the sleeve 32 is forced against the end of the tapered bushing 18 causing the bushing to slide toward the rear stand 10 across the cooperating tapered surface of the upper spindle 16. The tapered bushing 18 expands to effectively form a tight fit between the upper forming roll 14 and the spindle 16. The same procedure is accomplished between the lower forming roll 14' and the respective spindle 16'. It will be understood that the spindles 16 and 16' are driven by associated drive motors to cause powered rotation of the forming rolls 14 and 14'.

When it is desired to change the forming rolls 14 and 14' to produce a tubing of another diameter or wall thickness, the tapered bushings 18 and 18' must be released by contracting the bushings. In the illustrated embodiment, the changeover may be effected by a pressure fluid actuated system which includes centrally disposed bores 36 and 38 formed in the spindles 16 and 16'. Since the structure is substantially identical for each of the spindles 16 and 16', only the upper spindle 16 will be described in detail. One end of the bore 36 is in communication with a fitting 40 provided with a zerk fitting 42 for the reception of pressure fluid. The opposite end of the bore 36 communicates with a fluid conduit 44 which is

formed to completely extend circumferentially around a fitting 46. The outlet of the conduit 44 is provided with an annular ring 48 which is adapted to slide outwardly of the rear stand against the tapered bushing 18 to urge the bushing towards the opposite end of the spindle 16 allowing the bushing to contract and thereby effect a loosening of the forming roll 14.

The lower forming roll 14' is tightened and loosened in the same manner as the upper forming roll 14.

In accordance with the provisions of the patent statutes, the present invention has been described in what is considered to represent its preferred embodiment. However, it should be understood that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.